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ABSTRACT

The relationships between medical school academic achievement and first year residency performance were investigated for the 1983 and 1984 graduates of the Medical College of Wisconsin. The analyses were designed to control for suspected differential resident expectations among the directors of various medical specialties, and were replicated to determine the stability of the findings. Completed forms were returned for 64% (119) of the 1983 graduates and 74% (160) of the 1984 graduates. For both 1983 and 1984 graduates, correlations between medical school achievement measures and mean residency performance ratings were low, but significant, with the exception of 1983 Alpha Omega Alpha membership which was also low but insignificant. While the medical school performance of outstanding residents was better than that of below average residents, it was not possible to distinguish between outstanding and average residents, nor between average and below average residents on the basis of medical school course scores. The findings support the use of academic variables in the residency selection process. However, their use as a single factor or as a method of screening out applicants from further consideration was, at best, justified only in the case of extremely high or low medical school achievement measures. (Author/SW)

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## ABSTRACT


### MEDICAL SCHOOL PERFORMANCE AS A PREDICTOR OF RESIDENT COMPETENCE

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Office of Academic Affairs, Medical College of Wisconsin

This study investigated the relationships between medical school academic achievement and first year residency performance for the 1983 and 1984 graduates of the Medical College of Wisconsin. The analyses were designed to control for suspected differential resident expectations among the directors of various medical specialties, and were replicated to determine the stability of the findings. For both 1983 and 1984 graduates, correlations between medical school achievement measures and mean residency performance ratings were low, but significant, with the exception of 1983 AOA membership which was also low but insignificant. A multiple regression of these data accounted for one quarter of the residency rating score variance when controlling for rating differences between medical specialties. Parallel analyses, between levels of residency performance and medical school achievement were carried out using analysis of variance. While the medical school performance of outstanding residents was better than that of below average residents, it was not possible to distinguish between outstanding and average residents, nor between average and below average residents on the basis of medical school course scores. This study supports the use of academic variables in the residency selection process. However, their use as a single factor or as a method of screening out applicants from further consideration is, at best, justified only in the case of extremely high or low medical school achievement measures.


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# MEDICAL SCHOOL PERFORMANCE AS A PREDICTOR OF RESIDENT COMPETENCE

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**INTRODUCTION:** In 1973 the ratio of first year residency (PG-1) positions to graduating U.S. medical students was 2:1. This ratio declined to 1.2:1 in 1986 and, in some competitive specialties, the ratio fell to Ø.5:1 (1). Although the resident interview continues to be the most widely used criterion in the resident selection process, the increase in competition for PG-1 positions has lead residency program directors to place increased reliance on academic variables (2, 3). The use of medical school performance measures for selecting residents can be questioned unless their efficacy in predicting resident competence can be demonstrated.

Previous studies have investigated the relationship between resident performance and undergraduate GPAs, Medical College Admissions Test scores, pre-clinical grades and exam scores, clerkship performance ratings, and National Board of Medical Examiners performance (4-7). While only low to moderate zero-order correlations have been found, some researchers have reported that stronger relationships exist at the highest and lowest performance groups (6, 7). Wagoner et al. have indicated that membership in Alpha Omega Alpha (AOA) is of considerable importance in the residency selection process (3). Weiss et al. have reported that residents who were

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**PREDICTING RESIDENT PERFORMANCE**

AOA members were more likely to receive above average performance ratings than non-members (7). Several investigators have studied the utility of the Dean's letter of recommendation in selecting residents and its relationship to post-graduate performance. Although disparate findings have been reported (8-11), Stimmel suggests that a well constructed Dean's letter provides a valid indicator of future resident performance (12). A combination of noncognitive and cognitive predictor variables has been shown to increase considerably the accuracy with which residence performance can be predicted (4). However, recent evidence suggests that inappropriate conclusions may be drawn about the relationship between performance before and after graduation if medical specialty is not taken into consideration (6, 12, 13).

This study was conducted to investigate the relationship between medical school academic performance and first year resident performance, as evaluated by residency program directors. The analyses were designed to control for suspected differential resident expectations among medical specialties and were replicated to determine the stability of the findings.

**METHODOLOGY:** An evaluation form was mailed to residency directors at the end of our 1983 and 1984 graduates' PG-1 year. Completed forms were returned for 64 percent (119) of the 1983 graduates and 74 percent (160) of the graduates of the class of 1984. The directors were asked to evaluate the resident on six areas of competency: dependability, presentation of historical information and physical findings, laboratory and diagnostic tests, problem identification, management strategy and overall

professional competence. The six-point scale ranged from one (outstanding performance) to six (unsatisfactory performances) with values of 3 and 4 demarcating the average range of performance. The six areas of competence were factor analyzed using the principal axis method. A one factor solution was obtained ( = 80.4% of variance) suggesting the form was measuring the perception of residents' overall competence. Thus, a mean performance score was computed by averaging ratings across the six traits.

The medical school course scores which were analyzed were the average of standard scores for courses taught in each of the first three years. Year 1 average was the mean of the cumulative examination scores in six courses, year 2 average was the mean of three major second year courses, and year 3 average was the mean of the three final examinations administered at the end of the required clerkships in Medicine, Obstetrics and Gynecology, and Psychiatry. Other medical school measures included National Board of Medical Examiners Part I and II total scores (NBME I and NBME II), third and fourth year medicine clerkship evaluations, election to Alpha Omega Alpha, and a four category ranking of the Dean's letter of recommendation. The rank represented the writer's assessment of the graduate as a candidate for residency based upon cognitive and noncognitive factors.

In order to determine whether the samples were biased, t-tests were conducted on the independent variables. Comparison of the means revealed no differences between the graduates for whom residency evaluations were returned and those for whom evaluations were not returned. However, for two of the nine independent variables, year 2 average and NBME I, the variances of the 1983 non-returned group were significantly larger than the returned

group ($p < .05$). Among the 1984 graduates, the year 2 average variance was also larger for the non returned group ($p < .05$).

In order to study the effect of specialty on resident performance ratings, the 1984 graduates were assigned to one of six categories based on their PG-1 specialty; 1) Internal Medicine; 2) Family Practice and Pediatrics; 3) other medical specialties (OB/GYN, Psychiatry and Neurology); 4) surgical specialties (Surgery, Orthopedics, Otolaryngology, Anesthesiology and Urology); 5) support specialties; and 6) Transitional. Analysis of variance revealed significant differences among specialty groups ($F(5, 154) = 4.1$, $p < .001$). Residents who entered Internal Medicine programs received, qualitatively, the lowest ratings ($x = 2.7$) while those who entered surgical specialties received the highest ($x = 1.9$). The mean rating for Family Practice/Pediatrics ($x = 2.3$), other medical specialties ($x = 2.2$), support specialties ($x = 2.2$), and Transitional ($x = 2.3$) were of equal magnitude. Subsequent analyses of variance of medical school achievement scores by specialty indicated no significant differences between groups. In fact the medicine residents performed as well in medical school as the surgery residents.

This finding suggested that medicine residency directors were more stringent raters than directors who evaluated residents in surgical specialties. Thus, in order to control for residents' medical specialty, the nominal-scaled specialty variable was converted to a set of stand-in dummy variables. Each category of medical specialty was treated as a separate variable, whereby, all cases were assigned a score depending upon their presence or absence in each of the specialty categories. For statistical

reasons only five of the six dummy variables were included in the subsequent analyses.

Pearson product-moment correlations were computed between residents' mean rating score and the medical school variables. Parallel analyses between levels of residency performance and medical school performance were carried out using one-way analysis of variance. For the analyses of variance four independent variable groups were formed based on residents' ratings on the overall professional competence trait. It was felt that assignment to performance groups based on a discrete variable (overall competence trait) was less arbitrary than assignment to groups on the basis of a continuous variable (mean rating score). Residents who received an outstanding rating formed group 1, those who received a 2 formed the above average group and those given a 3 made up the average performance group. Residents who received a rating of 4, 5 or 6 were combined to form a single low performance group. In order to determine the stability of the findings, Pearson product-moment correlations and analyses of variance were employed independently for the class of 1983 and 1984.

Multiple regression was employed in order to evaluate how variables could be combined to find the best prediction equation for residents' mean performance. Two sets of predictor variables were entered into the multiple regression equation using a hierarchical-stepwise method with pairwise deletion of missing data. The set of stand-in specialty variables was entered first into the equation. The second set consisted of medical school variables which had correlated consistently (for the class of 1983 and 1984) with resident performance. Since our data base only included specialty data

for the 1984 graduates, multiple regression analyses were not done for the class of 1983.

**RESULTS:** Table 1 presents the zero-order correlations between medical school achievement variables and residents' mean performance rating. While some correlations were negative, they were in the expected direction given that a rating of 1 represents outstanding performance. Although the correlations were low, all were statistically significant with the exception of AOA, class of 1983. For both the classes of 1983 and 1984, NBME II had the highest correlation ($r = -.37$) with the mean resident rating. Other significant correlations ranged from $r = -.16$ (1984 AOA membership) to $r = -.33$ (1984 NBME I). Although the magnitude of the correlations varied across the 1983 and 1984 samples, a series of t-tests comparing the class of 1983 and 1984 correlations indicated no statistically significant differences between years.

In order to obtain a more stable estimate of the relationships between medical school and resident measures, correlations were averaged across samples using Fisher's r to z transformation. With the exception of AOA membership, all of the predictor variables correlated significantly with resident performance. However, even the strongest relationship (that between NBME II and mean resident ratings) only accounted for 14 percent of the variance in resident ratings.

In order to determine whether the predictive efficiency could be increased, multiple regression was employed combining, first, a set of stand-in specialty variables and, secondly, the medical school measures. As seen in Table 2, controlling for residents' specialty explained 13 percent of the

variance in resident ratings (R = .36). When the set of medical school measures was entered, another 13 percent of the remaining variance was explained by NBME Part II scores alone. The three variable weighted model had a multiple correlation of R = .51 which accounted for 26 percent of rating score variance. When the same procedure was conducted with NBME II removed from the second set of predictors, the resulting model included the year 2 average score and the fourth year Medicine evaluation. The multiple correlation of this model was also R = .51.

Although the amount of variance explained independently by each predictor variable was small, the relationships between achievement variables and resident performance were stronger at the extremes of the performance continua. Analyses of variance of the medical school variables by four levels of overall resident performance revealed significant differences between means for year 2 average scores, fourth year medicine clerkship ratings and NBME I and II scores for both the class of 1983 and 1984 (see Table 3). Significant differences for the class of 1983 also existed between performance groups for year 1 and year 3 average scores, and the third year medicine clerkship evaluation. They were not, however, significant for the class of 1984. For both samples, there were no significant differences between resident performance groups for AOA membership and the Dean's letter rank.

The omega squared ( $^2$) corresponding to each F-statistic is presented in Table 3. While differences were found between performance groups on several medical school measures, the amount of achievement variance explained by resident performance ( $^2$) was small. Within the resident performance

groups, there was considerable variation in achievement for each medical school measure. For example, while the mean NBME II score was higher for the outstanding group than for the low group, some low group residents out performed some residents in the outstanding group.

Post-hoc tests (Tukey B) were conducted on the four variables for which there were significant findings in both samples (year 2 average, year 4 clerkship ratings, NBME I and II). For these variables, residents who received outstanding overall performance ratings (group 1) had higher mean scores than residents who received low ratings (group 4). The above average and average groups(groups 2 and 3) also had higher NBME II means than group 4. These findings were consistent for the classes of 1983 and 1984. For the class of 1984, the group 2 NBME I and year 2 average means were higher than group 4. Analysis of variance findings indicated that the medical school course performance of outstanding residents was consistently higher than that achieved by below average residents. However, it is generally not possible to distinguish between outstanding residents and average residents, nor between average residents and below average residents on the basis of past medical school academic criteria.

**DISCUSSION:** The present study indicates that there are low, but statistically significant relationships between measures of medical school academic achievement and ratings of residency performance. It should be noted that multiple regression analysis of these data produced a prediction equation which accounted for only one quarter of the residency rating score variance. While this is not large in an absolute sense, it represents the level of predictive validity obtained by many educational tests. The low

predictive validity may be explained by the assumption that achievement measures predict only students' potential for resident performance and not the realization of their potential.

Wagoner et al. (3) have reported that academic variables are being given increasing weight in the residency selection process, especially by directors of programs in the most competitive specialties. More importantly, these variables are being used as screening criteria to determine which applicants will be interviewed. Because the predictive value of academic measures is low, their use as a single factor or as a screening device is, at best, justified only in the case of extremely high or low values.

The lack of a consistently significant correlation between AOA membership and residency performance was unexpected. Residency program directors utilize AOA membership as a significant selection criterion. Weiss and colleagues (7) found AOA membership to be a valid predictor of the performance of residents at the Beth Israel Hospital, Boston. However, acceptance to residencies at this hospital is competitive and a high proportion of the residents were members of AOA. Our data does reveal that it was extremely unusual for an AOA member to perform poorly as a resident: Only one of the 45 AOA members included in this study was ranked in the low performance group. However, most of our AOA graduates received above average, rather than outstanding residency performance ratings.

This study demonstrated the confounding effects of specialty on residents' ratings. Comparisons of numerical ratings of residents between specialities should be approached with caution. The data suggests that

specialties differ either in stringency of ratings or in the emphasis given to different competencies.

Finally, it should be noted that throughout this paper the ratings made by the program directors were assumed to be valid and reliable. Although this is a questionable assumption, these ratings do reflect the perceptions of the program directors and as such should not be minimized.

**CONCLUSIONS AND IMPLICATIONS:** These data support the use of academic variables as one of several factors to be considered in the selection of residents. The use of any of these variables as a single factor or as a method of screening out applicants from further consideration is not justified, and can result in the elimination of many applicants who will perform very well as residents.

**Table 1**

**Pearson Product Moment Correlations Between Average PGY-I Resident Performance Ratings and Medical School Achievement Variables for the 1983 and 1984 Graduates of the Medical College of Wisconsin**

| | Class of 1983 (n = 119) | | | Class of 1984 (n = 158) | | | Average of 1983 & 1984 Classes [1] | | |
|---|---|---|---|---|---|---|---|---|---|
| | r | $r^2$ | p | r | $r^2$ | p | r | $r^2$ | p |
| Medical School | | | | | | | | | |
| Year 1 Average | -.27 | .07 | ** | -.24 | .05 | *** | -.26 | .07 | ** |
| Year 2 Average | -.28 | .08 | *** | -.29 | .08 | *** | -.29 | .08 | *** |
| Year 3 Average | -.26 | .07 | ** | -.25 | .06 | *** | -.26 | .07 | *** |
| Medicine Year 3 | -.28 | .08 | *** | -.19 | .04 | ** | -.24 | .06 | ** |
| Medicine Year 4 | -.27 | .07 | ** | -.23 | .05 | *** | -.25 | .06 | ** |
| AOA Membership | -.14 | .02 | --- | -.16 | .03 | * | -.15 | .02 | --- |
| Dean's Letter Rank | .20 | .04 | * | .22 | .05 | ** | .21 | .04 | * |
| N.B.M.E. | | | | | | | | | |
| Part I Total | -.24 | .05 | ** | -.33 | .11 | *** | -.29 | .08 | *** |
| Part II Total | -.37 | .14 | *** | -.37 | .14 | *** | -.37 | .14 | *** |

1 Statistical significant value for the average correlations were based on a sample size of 119 graduate (Class of 1983).

* $p < .05$
** $p < .01$
*** $p < .001$

The negative correlations were in the expected direction given a 6 point resident rating scale with 1 = outstanding and 6 = unsatisfactory.

**Table 2**

**Stepwise Multiple Regression Analyses[1] of Significant Medical School Achievement Variables in the Prediction of Average PG-I Resident Ratings for 1984 Graduates of the Medical College of Wisconsin**

| | | r | R | $R^2$ | $R^2$ change | t |
|---|---|---|---|---|---|---|
| SET 1 | Dummy Variables | | | | | |
| | Step 1 Medicine Specialty | .31 | .31 | .10 | .10 | 4.10 |
| | Step 2 Surgical Specialty | -.22 | .35 | .13 | .03 | -2.18 |
| SET 2 | | | | | | |
| | a) Achievement Variables | | | | | |
| | Step 3 NBME II | -.37 | .51 | .26 | .13 | -5.15 |
| | b) Achievement Variables (with NBME II removed) | | | | | |
| | Step 3 Year 2 average | -.29 | .48 | .23 | .10 | -4.48 |
| | Step 4 Medicine 4 rating | -.23 | .51 | .26 | .03 | -2.35 |

1 The first analysis included the dummy variables and all significant achievement variables. The second analysis included the dummy variables and all achievement variables, with NBME II removed.

**Table 3**

**Analysis of Variance of Medical School Achievement Measures by Four Overall PG-I Professional Competence Groups for the 1983 and 1984 Graduates of the Medical College of Wisconsin**

| | Class of 1983 | | | Class of 1984 | | |
|---|---|---|---|---|---|---|
| | F | p | $\eta^2$ | F | p | $\eta^2$ |
| Medical School | | | | | | |
| Year 1 Average | 3.15 | * | .054 | 2.53 | --- | --- |
| Year 2 Average | 3.38 | * | .058 | 4.68 | ** | .065 |
| Year 3 Average | 3.59 | * | .064 | 2.41 | --- | --- |
| Medicine Year 3 | 2.91 | * | .037 | 1.53 | --- | --- |
| Medicine Year 4 | 2.98 | * | .050 | 3.56 | * | .046 |
| Dean's Letter Rank | 1.49 | --- | --- | 2.16 | --- | --- |
| AOA Membership | 1.26 | --- | --- | 2.25 | --- | --- |
| NBME | | | | | | |
| Part I Total | 2.83 | * | .045 | 6.13 | *** | .091 |
| Part II Total | 6.12 | *** | .119 | 7.59 | *** | .111 |

* $p < .05$
** $p < .01$
*** $p < .001$

Table 4

**Post-hoc Tests (Tukey B)**
**for Year 2 Average, Medicine 4 Clerkship Rating, and**
**National Board Part I & II, Which Were Significant in Both 1985 & 1984 Samples**

| | Resident Performance Groups | | | |
|---|---|---|---|---|
| | Outstanding | Above Average | Average | Below Ave.-Unsatisfact. |
| Outstanding | ——— | | | |
| Above Average | N.S. | ——— | | |
| Average | N.S. | N.S. | ——— | |
| Below Average-Unsatisfactory | Yr.2 Ave. (83/84)<br>Medicine 4 (83/84)<br>NBME I (83/84)<br>NBME II (83/84) | Yr.2 Ave. ( /84)<br>N.S.<br>NBME I ( /84)<br>NBME II (83/84) | N.S.<br>N.S.<br>N.S.<br>NBME II (83/84) | ——— |

N.S. - Non-significant difference between groups.

## References


1. Graettinger, J. NRMP DATA - April 1986. National Resident Matching Program, PGs. 2-27, 1986.
2. Wagoner, N., Gray, G.T., Report on a Survey of Program Directors Regarding Selection Factors in Graduate Medical Education. J.M.E., 54:445-452, 1979.
3. Wagoner, N., Suriano, J., Stoner, J.,. Factors Used by Program Directors to Select Residents. J.M.E., 61:10-21, 1986.
4. Keck, J., Arnold, L., Willoughby, L., and Calkins, V. Efficacy of Cognitive/Non Cognitive Measures in Predicting Resident Physician Performance. J.M.E., 54:759-765, 1979.
5. Veloski, J., Herman, M., Gonnella, J., Zeleznik, C., Kellow, W. Relationships Between Performance in Medical School and First Postgraduate Year. J.M.E., 54:909-916, 1979.
6. Gonnella, J. and Hojat, M. Relationship between Performance in Medical School and Postgraduate Competence. J.M.E., 58:679-685, 1983.
7. Weiss, S., Rosa, R., Jofe, T., and Munoz, B. A Prospective Evaluation of Performance During the First Year of the Medical Residency. J.M.E., 59:967-968, 1984.
8. Clemente, M., and Michener, M. The Dean's Letter of Recommendation and Internship Performance. J.M.E., 51:590-592, 1976.
9. Stanton, B., Burstein, A., Kobos, J., and Loucks, S. The Dean's Letter of Recommendation and Resident Performance. J.M.E., 54:812-813, 1979.
10. Stimmel, B. The Use of Pass/Fail Grades to Assess Academic Achievement of Housestaff Performance. J.M.E., 50:657-661, July, 1975.

11. Stimmel, B., Letters of Recommendation. J.M.E., 57:427, 1982.

12. Tardiff, K. The Effect of Pass-Fail on the Selection and Performance of Residents. J.M.E., 55:656-661, 1980.

13. Ronia, A., Golmon, M., Shanks, C., et al. Relationship Between Past Academic Performance and Results of Specialty In-Training Examinations. J.M.E. 59:341, 1984.

11. Stimmel, B., Letters of Recommendation. J.M.E., 57:427, 1982.

12. Tardiff, K. The Effect of Pass-Fail on the Selection and Performance of Residents. J.M.E., 55:656-661, 1980.

13. Ronia, A., Golmon, M., Shanks, C., et al. Relationship Between Past Academic Performance and Results of Specialty In-Training Examinations. J.M.E. 59:341, 1984.